able authority issuing eugenic certificates to candidates for them. They would imply more than an average share of the several qualities of at least goodness of constitution, of physique, and of mental capacity.

The discussion on the papers was opened by Dr. Haddon, who said Mr. Galton sought to establish a science of eugenics, he took it, because the postulates of eugenics were an inevitable corollary from the general doctrine of organic evolution—in the building up of which Mr. Galton had played a notable part. The evolution of the species having reached a self-conscious stage in man, it followed of necessity that increasingly rational and coordinated attempts should be made to guide and direct the evolutionary process towards definable and verifiable ideals. It was, as he understood it, the aim of eugenic studies to ascertain the means available for this rational guidance of human evolution, and the defining of the ideals towards which it should be directed. There was ample warrant in anthropological data for the assumption that in the development of marriage customs there was a tendency towards adaptation to higher social purposes.

Dr. F. W. Mott said there were two general ways towards the rational improvement of the stock:—(1) by checking the reproduction of the unfit, and (2) by encouraging the reproduction of the fit. For the former purpose the readiest means would be the segregation of defective children while quite young, and the curtailment of their social privileges as they grew to maturity. As regards means towards the encouragement of fertility in the higher types, he suggested as an initial tentative in practical measures a further development of the present system of marriage registration. Why, for instance, should not medical as well as legal certificates of marriage be procurable at registry offices? The former would be of the nature of a bill of health, certifying that the contracting parties reached a certain standard of hygienic requirement. Such certificates would of course be voluntary, but since they would be valuable not only to their possessors but also to their children, they would tend to come into general usage. In any case he considered it a matter of national importance that Mr. Galton's conception of eugenics should be most seriously considered. The first desideratum was to get it accepted as a legitimate and hopeful study.

Mr. Ernest Crawley said Mr. Galton's paper showed how anthropological studies could be made fruitful in practical politics. Sociology should be founding its science of eugenics upon anthropology, psychology, and physiology. He hoped that while chiefly considering the normal individual it would not forget the special claims of those abnormal persons whom we call geniuses. In a well ordered State they should be considered before the degenerate and the diseased. As regards marriage customs, he took it as an assured generalisation of anthropological science that there are two permanent polar tendencies in human nature, first against unions in the same home, and secondly against too promiscuous marriage. Many customs assumed by early anthropologists as normal types were, he believed, mere sports—such as group-marriage, and marriage of brother and sister. Polygamy he believed to be an example of a certain tendency in man to confuse sexual (*i.e.* organic), with matrimonial (*i.e.* social) concerns. They must beware of this confusion, and therefore be on their guard against its possible effects in studying eugenics. Mr. Galton's suggestion that religion was called upon to play a part in the development of eugenics he considered to be a sound deduction from history and anthropology. In the sanctification of marriage, religion had one of its earliest and greatest functions; and as primitive religion, in this as in other respects, was based upon the best knowledge of primitive times (*i.e.* upon primitive science), so the most developed form of religion should be illuminated by the most advanced form of knowledge (*i.e.* by contemporary science).

Dr. E. Westermarck said he entirely agreed with Mr. Galton's contention that restrictions in marriage as they existed in the simpler social formations, so they might be further modified and developed for eugenic purposes amongst the most highly civilised peoples. The germ of eugenic intentions was well seen amongst savage and barbarian peoples in those customs which imposed a test of fitness on the husband before marriage. In Kaffir tribes, for instance, a man may not marry until he has demonstrated his strength and courage and competence in the chase by killing a rhinoceros. In the Malay Archipelago there are peoples where the marriage test consists in the collection of a number of skulls from hostile tribes. Among the Arabs of Upper Egypt, the young aspirant to marriage must evidence his courage and self-control by suffering—with smiling countenance—a severe ordeal of whipping by the relatives of the bride. He considered that on this question of marriage, whereby the individual was brought into both organic and social relation with the species, moral teachers had before them one of the greatest of tasks, in inculcating a keener sense of foresight in the individual. There was perhaps hardly any other point in which the moral consciousness of civilised men stood in greater need of intellectual training.

As contributions to the discussion, a considerable number of written communications were received, from the following amongst others:—Dr. Havelock Ellis, Mr. A. H. Huth, Dr. Max Nordau, and Profs. Yves Delage, J. G. McKendrick, Posada, Sergi, Steinmetz, Tonnies, and Weismann. The last named raised the question whether, when a hereditary disease like tuberculosis has made its appearance in a family, it is afterwards possible for it to be banished entirely from this or that branch of the family, or whether, on the contrary, the progeny of those members who appear healthy must not sooner or later produce a tuberculous progeny. He himself considered that a tainted stock might produce a branch entirely free from that specific disease.

Mr. Galton, in the course of his reply, said it gave him satisfaction to find that no one amongst his critics had impugned the conclusion which his memoir on "Restrictions in Marriage" was written to justify.

THE ABSORPTION OF LIGHT BY THE ATMOSPHERE.[1]

THE great attention that has been paid during the last few years to the subject of photometry has brought into prominence the problem of the amount of light absorbed by the atmosphere. At the same time, the improvement that has taken place in the instrumental means, which renders possible the detection of minute changes in lustre, has required the use of accurate corrections by which the effect of the earth's atmosphere can be eliminated from the observations. The corrections which have been applied to photometric measures have been based generally on empirical or interpolation methods rather than on a strictly physical basis. There are several reasons which have contributed to this unsatisfactory condition of the problem. The difficulty of computing the length of the path of the ray of light in its passage through our atmosphere, the want of homogeneity in the constitution of the atmosphere itself, our ignorance of the law of the temperature gradient at considerable heights above the surface, and of the distribution of water and dust particles near the surface, have all complicated a subject the theory of which under ideal limiting conditions may not be very difficult. Bouguer left a very satisfactory theory, based, however, on the assumption that the path of the ray was rectilinear. Laplace attacked the subject from the side of the theory of refraction, but practically did not much advance it. From that time onward, the question has rather been left in the hands of observers, who have been content to make their observations homogeneous by the employment of an interpolation formula, based on the results of their actual practice.

Dr. A. Bemporod thinks that the time has come for the discussion of a physical theory of the extinction of light in the atmosphere, and certainly his pamphlet bearing this title is a most welcome contribution to this subject. It may be that in some sense it is a premature effort. That is to say, that the data for a complete solution of the problem do not exist. The series of observations which are now being conducted by means of kites and balloons, and which have for their object the examination of the different

[1] "Zur Theorie der Extinktion des Lichtes in der Erdatmosphäre." By Dr. A. Bemporod. Pp. 78. (Mitteilungen der Grossh. Sternwarte zu Heidelberg.)

strata of the atmosphere at various distances remote from the surface, may be expected to throw some additional light upon the constitution of the gaseous envelope through which the light passes, and, moreover, there is the troublesome and disturbing question of selective absorption, the importance of which the author fully admits, but does not consider numerically in his work, which may play a very important part in the future theory of atmospheric extinction. But any improvement which may hereafter be made will not invalidate the calculations, so far as they refer to the mass of the air through which the light beam penetrates.

Dr. Bemporod divides his work into five sections. In the first he presents the problem in its most general form, and defines the function $F(z)$, the so-called path of the ray in the atmosphere. Chapter ii. exhibits a critical examination of the theories of Bouguer, Lambert, Laplace, and of some others less well known. In the next the author discusses the hypotheses of Ivory and Schmidt on the constitution of the atmosphere. Of the two, Schmidt's hypothesis of a uniform decrease of the temperature with the height above the surface gives the best agreement with the observed temperatures derived by Assmann and Berson from balloon ascents. The latter hypothesis is the one therefore selected for development, but both Ivory and Schmidt give practically the same values for extinction, while Laplace's theory at the zenith distance of 87° appears to be a tenth of a magnitude in error. Chapter iv. explains the formation of the extensive numerical tables that accompany the work, and in the last the author has some remarks on the influence of geographical position on the absorption, as well as of the effects of oscillations in temperature and pressure. The whole forms a valuable addition to a subject of great interest and importance.

JOHN HUNTER AND HIS INFLUENCE ON SCIENTIFIC PROGRESS.[1]

AS the history of philosophy, considered from one point of view, is the record of the development and growth of ideas and of the formation of beliefs and doctrines respecting man and the universe accomplished through the thinking of a few great *minds*, so the history of medicine is a record of the observations, thoughts, and achievements of a few great *personalities*—Hippocrates, Celsus, Galen, Paré, Harvey, and John Hunter, to name only the greatest. John Hunter is the theme which has been assigned to me.

Throughout the ages of civilisation the growth of knowledge has been slow and often irregular, but it has been continuous and it has been sure. How slow and yet how sure we may realise by comparing the dialectic notions of Aristotle respecting weight and motion with the direct appeals to the evidences of the senses afforded by the demonstrations of Galilei, whereby it was shown that, so far from there being in nature bodies possessing positive levity, all matter is equally affected by gravity, irrespective of its form, magnitude, or texture. By the simple experiment of dropping objects from the Tower of Pisa, Galilei, who began life as a medical student, laid the foundation of modern physical science, and especially of dynamics. This expedient was one of the first appeals, at least in modern times, to the use of direct experiment in physical science, and the truth thereby established became a determining factor in Newton's great discovery of the law of gravitation. From Aristotle to Galilei an interval of more than eighteen centuries had elapsed. Galilei and Harvey were contemporaries.

John Hunter was born exactly a century after the publication of Harvey's "Exercitatio De Motu Cordis." It is one hundred and eleven years since John Hunter died. Yet how modern Hunter is! Inventions and discoveries now crowd upon us so thick and fast that we are apt to forget how recently modern physical science began, and especially modern medicine. In the order of time medicine, in its rudest and simplest forms, must have been one of the first of the empirical arts, but in the order of ideas it was one of the last to enter into the hierarchy of the sciences. As a system of organised knowledge medicine presupposes and requires not only centuries of clinical observation and a complete logical apparatus, but it also requires an advanced state of all the other natural sciences. It concerns itself with the recondite problems of life in the most complex and the most highly differentiated of its manifestations, whether under the conditions of health or under those of disease. Until physics and chemistry had advanced from the conjectural and the aprioristic to the scientific stage, medicine could only be conjectural and aprioristic too, however useful it may have been as a practical art. The thoughts and labours, the experiments and discoveries of the great pioneers of modern knowledge in the physical sciences were the necessary prelude to a scientific progress in biology, which, in its turn, was a condition precedent to any real advance in the science of medicine, surgery, and pathology. Harvey, in the order of time and of thought, was the necessary antecedent of Hunter.

The starting-point of John Hunter's career as anatomist, biologist, and surgeon was in the year 1748, when he came to London with a receptive and intelligent mind, a quick and observant eye, and a well-trained hand, to collaborate with his brother William in the anatomical school which had been started two or three years before.

Considering the important part that human anatomy now plays in medical education, it is difficult to conceive that there was no systematic teaching of anatomy in England before the middle of the eighteenth century. During the many centuries which elapsed between, say, the time of Hippocrates and the middle of the sixteenth century, the dissection of the human cadaver was almost unknown. Forbidden alike by the laws and customs and religion of the ancient Greeks, and by the creed of Mohammed, the study of human anatomy was placed under a civil and religious ban until the end of the thirteenth century. In ancient Greece the laws relating to immediate burial were very stringent. Even victorious generals had been condemned to death because they neglected to bury the slain. The pathos of Sophocles' tragedy of "Antigone" turns, it will be remembered, upon the sacredness of the dead, and of the necessity, higher than imperial commands, of immediate burial.

When the tradition of Greek medicine passed—in the seventh and eighth centuries—into the hands of the Mohammedans, human anatomy was equally neglected, the practice of dissection being implicitly forbidden by the Qurân. Even after the dissection of the human cadaver received the sanction of the civil authorities in southern Europe, the teaching of anatomy was cursory and occasional, and merely descriptive. Mundino of Bologna, in the fourteenth century, who was the first in modern times to dissect the human cadaver, seems to have dissected only two bodies. So little was known of human anatomy, and so strong was the tyranny of tradition, that when Vesalius, in the middle of the sixteenth century, alleged that the anatomical descriptions of Galen could not be adapted to man, there were not a few who, in their zeal to repel the accusation that Galen had used animals in dissection, did not hesitate to maintain that the human organisation had changed since Galen's time.

In England, notwithstanding Harvey lectures on anatomy in the first quarter of the seventeenth century, there was no organised teaching of anatomy before William Hunter's time. In this matter William Hunter has not received all the credit he deserves. Had his ambition been realised, he would, nearly a century and a half ago, have solved a problem in early medical education in London which is still perplexing the minds of many thoughtful persons. He desired to establish an anatomical school in London upon an extensive scale. With this object in view, he offered to erect a building at the cost of 7000l. for the study and teaching of anatomy provided the Government would grant him a piece of ground to build upon. It was also his intention to give to this institution all his preparations and his books. With a lamentable lack of sympathy which British Governments have too often manifested in their dealings with science and education, William Hunter's offer was declined. Smarting under a keen sense of disappointment and full of resentment, he determined to transfer his favours to Glasgow, which now enjoys the possession of his priceless museum and his library. *Beati possidentes.*

[1] Abridged from the Hunterian oration, delivered before the Roval College of Surgeons, February 14, by Mr. John Tweedy, president of the college.